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# AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 13.] MARCH, 1942. [No. 1.

## EDITORIAL.

As our first issue in 1942 goes to the press, copra producers and those associated with the industry will have heard with gratification the announcement that the Ministry of Food has agreed to purchase the whole output of Fiji copra at a price of £18 a ton f.o.b. Suva or Levuka. In view of recent developments in the Far East it is unlikely that the price will fall below this figure for the duration of the war at least; it is possible that future developments may lead to a further advance though boom prices, such as were enjoyed for a brief period after last war, are not to be expected under present conditions of almost world-wide commodity price control by Governments.

The new price was negotiated directly between the Governments of Fiji and of the United Kingdom. In the negotiations full consideration was given to the needs of the producer for adequate returns so that production may be fully and properly developed and so that a reasonable living may be secured to all primary producers in particular as well as to others concerned in the industry. It has been decided that all purchases of copra in Fiji shall be by Government for two reasons: first that future trade negotiations also are likely to be as between Governments, and it is therefore an advantage for the government concerned to be the owner of the commodity; and, second, by removing the speculative element normally inseparable from the purchase and export of copra, Government secures to the producer the full price, less only a necessary margin for handling, shrinkage, insurance, etc. In order to avoid the setting up of a purchasing organization by Government, the latter has come to an agreement with exporting interests whereby those merchants who satisfy Government that they have adequate storage and other facilities will purchase copra and will handle store, and ship on Government's behalf. As agents, the merchants will receive reasonable remuneration for their services.

For the present, Government is purchasing copra only on delivery at Suva and Levuka, producers wishing to obtain the declared Government prices should consign their copra to their usual purchaser or agent at these ports. At other centres in the Colony, prices offered by local traders will vary according to freight costs to Suva or Levuka, handling and storage facilities, etc. Purchase by Government may later be extended to include other centres, but it is expected that prices will automatically follow those ruling at Suva and Levuka with a reasonable margin for profit.

The f.o.b. price of £18 will be paid to the Government of Fiji by the Ministry of Food as a flat rate irrespective of quality. Government has, however, decided to follow the grading system, with a price differential, that has been in operation for the past year. Planters will therefore continue to be paid a higher price for Plantation than for Fair Merchantable Sundried grade, though the average of the prices for the two grades will be equivalent to £18 a ton f.o.b. less handling and other costs. Although it appears

likely that copra of any quality will be saleable during the war period and possibly for some time after, it is also likely that in course of time Fiji will once more be up against the same problem as in the few years before the war, viz. strong competition from other vegetable oils and from other copra producing countries where the industry is organized on a quality basis. It is, therefore, incumbent upon producers in this Colony to make the most of this opportunity afforded by reasonably profitable prices to equip themselves to turn out copra of good quality and Government has retained the price differential as an immediate incentive. Also it should be borne in mind that maximum production, which is now required, is only possible if the maximum out-turn of good quality copra is attained because poor quality copra indicates a material loss to the producer of primary produce and hence of remuneration for his labour. Imported materials are difficult to come by at the present time but a lot can be done with local materials in the way of extending *vatas* (driers) and stores; moreover we hope that the supply of some at least of the imported materials may improve and if this comes about it is to be expected that planters and storekeepers in the native areas will be in a position to make use of them and thus improve their facilities for the manufacture of a good quality product.

In the meantime it is requested that all will do their utmost to increase their output and improve their plantations and that producers will at last be able to feel that they are helping with the war effort as well as bringing in a reasonable return to themselves. Labour shortage is likely to hold up work on the rehabilitation of plantations but this is likely to improve with increased wage rates and better housing conditions that should now be possible. It is also hoped that constant attention will be devoted to the provision of family produced foodstuffs by labourers as this factor has an important bearing on their contentment and stability and on their general health as well as on the economics of production costs at the present time.

The essential importance of local food production is stressed in this number. The Senior Agricultural Officer, deals briefly with food crop production and the Senior Veterinary Officer writes at length on animal food production. The former states that immediately prior to the war, the Colony was producing some 12,000 tons of rice annually and he estimates that because of high costs of rice, shortage of imported supplies, increased costs of sharps and flour and constant propaganda, the present rice season, given reasonably good weather conditions, will produce a record crop. He points out the immediate need for increased successive monthly plantings of quick-growing food crops other than rice, such as kumalas, maize, cowpeas, etc., in order to provide abundant foodstuffs in the period that must elapse before the next rice harvest. He urges the need for constant effort to maintain normal plantings of root crops especially by Fijians whose produce can now find a ready and payable market. He also emphasises the advisability of utilising maize meal more in the diet in order to conserve supplies of imported sharps and flour and suggests that Europeans with available land should maintain sufficient plantings of root crops for their own use.

The Senior Veterinary Officer gives a concise statement of the present position in regard to meat supplies and numerous practical suggestions for effecting improvements which are now very necessary. There is no doubt that if advantage is taken of the many suggestions contained in this useful article, much headway can be made in the matter of meat production. Special attention is directed to pigs because they give returns so much more rapidly than cattle and an early increase is now urgently required.

The vital necessity of improving the diet of the people of the country so that benefit may accrue to their general health is brought home to us in an expert, comprehensive and yet simple article on the vitamins which should be carefully studied, especially by all employers of labour. The article indicates the best types of local food for the provision of the various necessary vitamins and shows that they may all be obtained readily by a reasonable choice of available locally produced foods. This article was prepared by the Senior Chemist at the request of the Fiji Nutrition Committee and it is hoped it will be given the attention it merits.

The present need for the conservation of our fresh meat supplies has already directed practical interest to the vast reserves of fresh food available to us in the great ocean in which the Colony is located. For some years past, the importation of large quantities of tinned fish into Fiji has been deplored and recently initial steps have been taken to regulate the fishing industry with the ultimate purpose of gaining necessary information on which to develop our natural marine resources so that fresh fish may be freely available to all at reasonable prices.

The Fijians, living on their coral-surrounded islands, are apt fishermen and have always depended extensively on fresh fish as the main protein constituent in their diet but they have not been able to organize their fishing industry adequately to meet the increasing needs of those sections of the community which have neither the aptitude nor the facilities to catch fish for themselves. Furthermore, the same lack of marketing facilities as has hampered the fuller development of locally grown agricultural produce has hindered the expansion of local fisheries which require to be organized in order to attain their full value to the community as a regular source of nutritious fresh food.

The Fijians do, however, appreciate the close linkage between agriculture and fisheries since the vast majority of the natives are primarily agriculturists who grow most of their own food and at the same time depend largely on the fish they catch to balance their diet which is predominantly starchy in composition. Hence the Fijians, and those who have Fijian interests at heart, will read with much interest the article contained in this issue on the relationship between fisheries and agriculture which has been written by an eminent authority in Palestine.

It may be mentioned that the pressing need for adequate supplies of fresh fish at the present time has led to a recent decision by Government to provide facilities for the adoption of practical means to organize the catching and marketing of fish for the benefit of the public. It is therefore hoped that adequate supplies of fish will become available to residents of Suva within the next month or two.

Another article of interest is that on water control, the method described has been found to give satisfactory results in the Waimaro district and anyone interested who is passing along the King's Road would be welcome to see the dam in operation.

The Entomologist deals with several insect pests which have come to the fore recently and his annual report for last year is also printed. Finally, of three articles by the Agricultural Officer Southern, that on the various varieties of rice grown in his division last year is of the greatest importance in view of the strained shipping resources in the Pacific.

## FOOD PRODUCTION.

By
C. HARVEY, B.Sc., A.I.C.T.A.,
Senior Agricultural Officer.

THE present shortage of rice, potatoes and sharps will have brought home to the Indian and also the European communities the wartime dangers of relying too much on imported foodstuffs.

Sharps cannot be grown in Fiji but maize grows well and maize meal can replace sharps and wheaten flour to some extent; in the western districts many Indian consumers have for some time been mixing their sharps half and half with maize meal for economy's sake and this should be more general now in order to conserve supplies of sharps. At the time of writing (early February) bread is being manufactured for sale in Sigatoka from flour containing 25 per cent admixture of maize meal.

Potatoes can only be grown with real success in certain parts of the Colony, principally the Sigatoka valley, where soil and climate suit the crop. The season is comparatively short and locally grown potatoes do not store well; for this reason local demand can only be met for a few months of the year even with maximum production, while it must be remembered that the demand for this vegetable has greatly increased with the much larger European population. For the remaining period it now becomes necessary to rely on yams, kumalas, tapioca and dalo unless imported supplies come forward.

Prior to the outbreak of war the Colony was producing an estimated total of 12,000 tons of rice per annum, a large proportion of which was consumed by the growers themselves. Imports varied from 2,000 to 3,000 tons according to season. Efforts to extend plantings were made during 1940 and 1941 but these were nullified by unduly dry weather. After a bad start, with a drought in December and January, the present season gives promise of a record crop, and it seems probable that Fiji will this season approach nearer to self-sufficiency in rice than at any previous time. There has been a considerable increase in the number of farmers growing rice, largely due to the action of the Colonial Sugar Refining Company Limited in permitting all their tenants who have no access to other rice land to plant up to one acre of rice on their cane fallows. Many other farmers who have not previously grown rice and many Indians employed in townships or outside who have been able to secure suitable land, have this year prepared land for this crop. There has been a large demand for seed; all regular growers made use of their own seed, but Government has supplied over 21 tons to new growers, principally to Colonial Sugar Refining Company tenants through the Company's mill managers, while many other new comers to rice planting have been able to secure seed from their neighbours. The number of Fijians growing rice has also increased, and this portion of the crop will be wholly available for the local market as consumption of rice by Fijians in country districts is very small.

Plantings by Fijians, especially, of the common root crops (dalo, kumalas and tapioca) have greatly increased since the outbreak of war, and many more Europeans and Indians now have small plots of these crops. However, the demand has recently overtaken even the increased supply, firstly by reason of the greatly increased non-producing population engaged on military duties or defence works, and latterly because of the lack of imported potatoes and the shortage of rice. The obstacles to the attainment of self-sufficiency

in bulk foods are exemplified in the periodically recurring gluts and shortages since the outbreak of war, when a general extension of food plantings was called for by His Excellency the Governor. For the first year of the war supplies of most imported commodities continued normal and in consequence there was a greater production of root crops than could easily be absorbed; this was accentuated by the decision of the New Zealand Government not to import kumalas. This naturally had the effect of discouraging producers. Since then local demand has gradually increased, until at the present time, with imported potatoes unobtainable, short rice supplies, a greatly increased consuming population and the numbers of Fijian growers reduced by absorption into defence works, there is a definite shortage of root crops.

Prices have considerable influence on the production of surplus food crops for sale. In order to protect town-dwelling consumers during periods of temporary shortage Government has fixed the maximum prices of kumalas and dalo at 1d. per lb retail and £9 and £8 per ton respectively, wholesale. These prices are well in excess of normal prices, especially that for kumalas, and therefore offer inducement to growers within convenient distance of markets to produce a surplus for sale. The price of yams is not controlled at the present time; last season they fetched as much as 15s. per cwt. on the Suva Market and a considerably larger crop is expected this season.

It appears likely that the demand for root crops will continue to be steady for some time to come but as a further guarantee against loss Government has agreed to purchase all dalo, kumalas and yams delivered at Suva, Nausori and Sigatoka, at £5, £4 10s. 0d. and £8 per ton respectively (yams £7 only at Nausori and Sigatoka). These prices are considerably lower than those ruling at the present time, but they do insure producers against total loss through over-production.

There are welcome signs that the temporary shortage of rice and sharps has impelled Indian farmers to give more attention to the planting of kumalas and tapioca. Though these foodstuffs are less palatable to Indians than rice and sharps they nevertheless form a useful and easily grown reserve of bulk food, available throughout the year, and it is essential that every farmer should plant up a small plot and maintain fresh plantings in regular succession. It is probable that imported supplies of dhall and spices will also be short, and Indian farmers should, therefore, plant up additional areas of dhall arhar (pigeon pea) in those districts where this crop flourishes (principally Nadi, Lautoka, Ba, Ra, Macuata and northern Bua) and elsewhere should plant cowpeas.

Recommendations are, therefore, in brief, that all Fijians should continue to plant up dalo, kumalas and tapioca sufficient for their own needs, and that those conveniently situated for transport to a market should plant up each month half a chain to a chain of kumalas and dalo, particularly, for sale. They should in addition increase their seasonal plantings of yams when the time comes; although more laborious than kumalas and dalo in planting and digging this crop is particularly useful and profitable as it can be stored for a considerable time, and it fetches higher prices in Suva than the other root crops. Indian farmers should maintain regular plantings of kumalas and tapioca, say one quarter to a half chain monthly, for their own consumption and for sale. They should, of course, plant up as much rice as possible, in season, and should also plant maize, dhall and chillies for home consumption and sale. Europeans with available land would be well advised to maintain sufficient plantings of the root crops for their own use.

## ANIMAL PRODUCTION IN WAR TIME.

By
C. R. TURBET, M.R.C.V.S., B.V.Sc.,
Senior Veterinary Officer, Fiji.

THE greater number of consumers of animal products now resident in Fiji have turned a previous condition of over production, or of at least sufficiency into an actual shortage of these commodities. The old adage that a soldier marches on his stomach holds good to-day and for troops to give of their best in opposing the enemy and for the efficient performance of work by the civilian population it is essential that the ration of animal foods available for both soldiers and civilians should be maintained at adequate level in relation to the normal requirement for work and the maintenance of bodily functions.

In regard to the quantities produced of the different kinds of animal products prior to the war there was over-production of beef cattle. Dairy products, milk, butter and ghee were just about sufficient for local needs. Pig production kept pace with the country's requirements in pork but not in hams and bacon. The number of sheep present in the Colony was not sufficient to provide an appreciable portion of our mutton requirements. Goats on the other hand are numerous and provided a fair meat ration for consumers amongst the Indian community. Egg production has been sufficient to meet local needs in the season from May to December. It has always been necessary, however, to import some eggs in the off season. Carcass poultry has been about equal to the demand for this class of food.

Of the different kinds of animal foods mentioned above the only one, the consumption of which has not markedly increased, is goat meat. All of the others are at present insufficient to meet present requirements.

To make up the local deficiencies from overseas would require the utilization of valuable shipping space so urgently needed for the carriage of munitions of war and other essentials not locally produced. It would mean also the loss to the Colony of funds sent overseas for the purchase of animal foodstuffs. This would be deplorable in view of the potential production capacity of this country.

In view of the above-mentioned facts therefore it is the duty of primary producers of all races in the Colony to strive by all means to increase the war time production of animals and foods of animal origin. As an aid towards the attainment of the desired objective an attempt is made in this article to explain reasons for certain actions and to encourage those engaged in animal production industries to develop their production along the right lines.

### BEEF.

The beef supply of the Colony is derived from (*a*) cattle bred primarily for that purpose; (*b*) coconut plantations where cattle are kept as weeders, being ultimately disposed of for beef; (*c*) dairy raised steers and culled cows; (*d*) the surplus male cattle raised by small Indian cultivators who, in most cases, keep a few head of cattle. Increased production is possible from each of the above sources. It is from the coconut plantations, however, that the biggest contribution is expected.

The low price obtained for copra and the difficulty of disposing of cattle raised on coconut estates before the war brought about a state of depression which resulted in the neglect of fencing, pasture and stock on many estates. Fences which fell into disrepair will need to be repaired or renewed. The shortage of wire will make this a problem but much may be done in the meantime by salvage of old wire and reorganization of paddocks. Most

estates will require the expenditure of considerable sums of money in weeding to make them capable of again carrying stock economically. The higher price now being obtained for copra should make funds available for estate maintenance, including weeding. It is to be hoped that this same increase will not lead to further neglect of cattle in favour of coconuts. The price now ruling for cattle (30s. per 100 lb dressed weight) should prove remunerative in view of the economical way in which cattle are raised on coconut estates.

The provices of Nadroga, Colo West and Bua have much land available for cattle raising for beef supply. In the absence of sufficient wire for the proper fencing of new cattle runs, the provision of night paddocks only would serve to enable cattle raising to be carried on for the time being. During daylight it would be necessary to herd the cattle. This is economical provided the number of cattle to be herded is large enough. By herding cattle there is the added advantage that the cattle become used to being driven.

Owners of cattle at this time should not neglect the early castration of their bull calves. Where there has been neglect, it is urged that the castration of unlicensed bulls be done forthwith so that these animals may become available to augment our beef cattle supply.

### Slaughter of Animals.

The increased numbers of cows being killed for beef in 1941 created the necessity for imposing restriction on the killing of these animals. Had the increased rate of slaughter of cows been permitted to continue it would have lead ultimately to a serious depletion of our breeding stock at a time when it is necessary to increase production as quickly as possible. The prohibition of the slaughter of cows under eight years of age applies at present only to cows slaughtered in registered slaughter-houses. All cattle owners are urged, however, to co-operate in the prevention of the slaughter of all potential breeding stock for other reasons than disease control. Wherever possible too, the carcasses of cattle killed on account of disease should be put to useful purpose; in some cases for human food after sterilization by cooking and in others as pig food.

It has been found necessary also to restrict the slaughter for food of young male cattle. Once a young steer reaches the weaner stage there is very little more to do than to keep it under control and to supply ample grazing in order to bring it ultimately to the most economical weight for slaughter. Very few cattle in this country reach maturity in under four years. The fixing of three years therefore as the minimum age for the slaughter of male cattle is reasonable. The Order applies only to cattle slaughtered in registered slaughter-houses; the co-operation, however, of all plantation managers and owners is sought to prevent the slaughter of immature cattle which, if left to mature will supply so much more meat food.

### Speying.

In the present emergency there is no justification for the speying of beef heifers and cows under eight years with view to herd improvement. Young cows which do not conform to the owners' fancy in regard to conformation, colour or horned or polled character, should be culled from the herd by sale. The speying of such animals deprives the country of the potentially large number of descendants they are capable of producing. For the time being the best that can be done is to mate culled young cows with better bulls and improve available grazing facilities.

In regard to the speying of cows on dairy farms, there is little demand for the speying of heifers. During normal times the speying of cows culled on account of low milk or butter fat yield is excellent practice. At this time, however, a low yielding young cow if placed on good pasture may still raise good beef. In culling dairy cattle therefore, owners should, as far as possible, be guided by such factors as age, necessity for disease control and physical defects rendering successful breeding problematical.

### Overstocking.

On some estates, overstocking exists to such an extent that pasture has been depleted so that there is now no chance of cattle being brought to a marketable condition. Owners finding themselves in such a predicament should dispose of a portion of their herd as stores. On the other hand there are some estates unable to breed sufficient cattle to stock their fattening paddocks. Where such conditions exist on estates reasonably accessible to each other, a readjustment of stock by transference from one estate to the other would obviously be of mutual advantage to each owner as well as to to the benefit of the food supply of the Colony.

### Dairying and Pasture Improvement.

Increased dairy production may be brought about most quickly by adding to the acreage available for grazing. On Tailevu farms, much bush land remains to be cleared and opened up. In other areas the eradication of weeds such as Solanum, Guava and Lantana, as well as the clearing of secondary bush growth, will add considerably to the available grazing area.

During the year just passed there was little mortality in calves. The result is that large numbers of young dairy stock will be coming into production in the next year or two. Now is the time for the preparation of pasture to absorb these young stock into the dairy herds.

In regard to pasture improvement much can be done by the elimination of roughage and by selective weeding. This will immediately increase the carrying capacity of the land. The grazing lands of most dairy farms in Fiji would be greatly improved by a judiciously planned drainage system. It would probably not be economical during war time to use imported artificial fertilisers, even if such could be obtained. The application of lime or coral sand, if easily obtainable locally, would be worth while. Each farm should have a portion of its area ploughed and sown wtih Para grass and subdivided to allow a system of rotational grazing. Rich tall para grass is itself sufficient to control weed growth if the grazing is well managed. Other fields may consist of short mixed pasture on which the cows should spend most of their time. Two periods daily of from one to two hours each is sufficient for the cows to eat their fill of para grass. They should be taken out of the para as soon as they cease feeding and commence to lie down. Weed growth in short pasture is more difficult to control. Selective weeding or mowing to a height of from four to six inches will be found most effective. Farm yard manure spread on rested fields will do much towards the maintenance of fertility especially, if it is well scattered by light harrowing or other means.

Owing to the fact that practically all butter fat received at the factories is now being consumed as butter, there is very little, if any, factory made ghee available. There is an ample market for ghee produced in centres not conveniently situated to supply a butter factory. All owners of small herds of cows are urged therefore to make as much ghee as possible.

### Pigs and Pork.

When the writer advocated the greater production of pigs during the first year of the war, the development of an export trade in bacon type carcasses was envisaged. Such a trade is not now possible. On the other hand the local demand for pork has so increased that this avenue of disposal remains to be satisfied. If cheap food is available pig raising gives quicker and more profitable returns than any other branch of animal industry (see previous articles in this Journal, Ref. [1] and [2]).

Whilst pigs of uniform quality and of bacon type would have been demanded for an export trade, local fancy is not so exacting. It should be easier therefore to produce pigs suitable for the local market. The trade is in fresh pork but pork from a bacon type pig is probably more appreciated than a true pork type. No difficulty should be experienced by prospective pig breeders in producing readily saleable animals.

### Sheep and Goats.

In animal production in war time there is little time for experimentation. Further efforts to put sheep breeding on a profitable basis might therefore be held in abeyance for the time being. Goat herdsmen might pay more attention to the early castration of males so as to bring larger numbers of goats into the food market. The establishment of butcheries specializing in the sale of goat meat at Suva, Nausori, Ba, Lautoka and Labasa should prove profitable to the proprietors and a useful service to the community. Greater production of goats is urged on those engaged in this class of animal breeding.

### Poultry.

Apart from the reward of good profits which are to be made from carcass poultry and egg production increased breeding should be undertaken as a war effort by all those who have facilities for doing so. All are agreed as to the food value of eggs and poultry for the maintenance of human health under normal conditions. During war with the increased toil and worry associated with it, the maintenance of supplies of this class of food to meet the needs of increased consumers is of great importance.

The provision of wire netting for the extension of fowl runs is a problem to be overcome. Probably the best method is to concentrate the flock onto the minimum floor area permissible (i.e. four square feet per bird). The whole area of floor should be laid in concrete with suitable drainage and ample roof area provided. It is wise to keep the birds off the floor under the roofed area by placing wire netting under the perches. The idea in this being to prevent the spread of worm infection through excessive contact with droppings such as would occur if the birds had access to the floor under the perches. The floor area to which the birds have access should be swept and washed down daily. Under this system two hundred birds may be maintained in an enclosure 40 feet by 20 feet.

The cement painted bag house([3]) is about as economical as can be built. The roof of this type of house should have a good slope to prevent sagging of the roof. It is preferable to build a long narrow house rather than the compact type. This prevents overcrowding. Having adopted this economical intensive housing system, it will be necessary to pay particular attention to proper feeding. If the birds can be let out for open grazing in the afternoons, feeding problems and the maintenance of health will be simplified.

### Feeding of Animals.

Increased animal production will require greater supplies of fodder. An extension of available grazing area together with pasture improvement should be sufficient to provide for cattle and horses. The country is well able to provide increased food for pig production. In this connexion full utilization of waste food from military camps and slaughter-houses is to be aimed at. A small quantity of this food only is being utilized. Whilst the war continues there must always be some difficulty obtaining in supplies of poultry foods from overseas. Under the circumstances therefore locally grown foodstuffs must be put to greater use. Coconut meal may form as much as twenty-five per cent of the total ration and maize meal or grain about thirty per cent: mashed boiled roots such as dalo, sweet potato and tapioca, twenty-five per cent: sieved rice bran ten per cent and meatmeal or skimmed milk ten per cent calculated as solids would provide a useful productive ration for both pigs and poultry.

A greater appreciation of the needs of the animal industry should be shown by agriculturists and millers. More often than not there is a shortage of maize and to obtain continuous supplies of maize meal at a reasonable price is a difficult matter. There is a tremendous loss of valuable animal food in the form of rice meal or polish, brought about by the use of the type of rice mill so common in this country. The rice meal or polish loses its value as a food by being mixed with the indigestible broken rice hulls in the milling process.

### Horses.

Leaving the question of food for the time being one must refer to the urgent need for the increased breeding of horses suitable for traction(1). One result of the war must be an early world shortage of petrol. Already agriculture is almost solely dependent upon animal traction. A return to horse traction for road transport and a greater use of hacks is envisaged. These facts should be recognized early and countered by increased breeding of suitable types.

### Land.

The greater production of animals will require an extension of the areas of land devoted to grazing. The following information is contributed by the Director of Lands as a guide to the procedure for acquiring land.

The leasing of available native land is in the hands of the Native Land Trust Board. Agricultural leases are issued for terms up to 30 years while the maximum term for a grazing lease is 50 years. Survey and other fees on leases are payable by lessees. The rentals depend on the class of country selected, and run approximately from 3s. to 20s. per acre per annum for agricultural leases, and 6d. to 3s. per acre per annum for grazing leases. Leases of Crown land are available on similar conditions, but are issued for 21 years only with an option of renewal for a further nine years. All leases are subject to improvement conditions.

### REFERENCES.

(1) Turbet, C. R. 1937.—*Agricultural Journal, Fiji*, Vol. 8, No. 3.
(2) Turbet, C. R. 1941.—Vol. 12, ibid, No. 1.
(3) Parham, W. L. 1941.—Vol. 12, No. 3.
(4) Turbet, C. R. 1941.—Vol. 12, No. 4.

## THE PRODUCTION OF RICE IN THE SOUTHERN AGRICULTURAL DIVISION IN 1941.

By
B. E. PARHAM, M.A., Agricultural Officer Southern.
and
B. RAMNATH, Indian Field Assistant.

THE present note may be compared with the report published in 1939 (2) dealing with rice production in the same area—viz. that part of Tailevui Naitasiri and Rewa Provinces at present forming the south-eastern and central part of the Southern Agricultural Division.

### NEW VARIETIES ISSUED BY DEPARTMENT OF AGRICULTURE.

Certain varieties have been under trial at the Central Agricultural Station since 1933 (1). Before making seed padi of these available for general distribution in the Colony it was decided to limit the issue of four of the varieties to growers in the Southern Division only so that field observations could first be made on their behaviour in a number of localities. The co-operation of growers was sought in order to facilitate observations and to control the future distribution of the crops.

The British Guiana varieties—B.G.79, B.G.75 and D.116—were the best yielding varieties; and Ramcajara was included owing to its great popularity with local growers who declared it to have the best flavour, milling and cooking qualities.

The following table indicates results of this preliminary distribution of seed.

TABLE I.—AREAS AND YIELDS OF NEW VARIETIES.

| Variety. | No. of Growers. | Area in acres. | Yield in lb. |
|---|---|---|---|
| Ramacajara .. .. | 40 | 29·45 | 48,610 |
| B.G. 75.. .. .. | 3 | 3·00 | 2,875 |
| B.G. 79.. .. .. | 3 | 1·90 | 375 |
| D. 116 .. .. .. | 1 | 0·30 | 500 |
| Total .. | 47 | 34·65 | 52,360 |

Heavy losses, estimated at 50 per cent approximately, were sustained owing to floods and the February hurricane.

All the growers concerned are anxious to continue with the cultivation of these varieties and have retained seed for that purpose—a total of 73 growers have now obtained seed and have planted approximately 100 acres for the 1941–42 season.

### OTHER VARIETIES.

There was a marked increase in the area devoted to rice cultivation. This was due to a number of reasons (1) the encouragement given by the Colonial Sugar Refining Company—which permitted each tenant to sow half acre of rice; (2) the prevailing shortage of rice and the high price; and (3) increasing interest of Fijian growers in this crop.

Considerable areas of new land were opened up for rice cultivation, especially in the Tailevu South area; and despite the adverse weather conditions—dry weather at planting season, floods and a hurricane during January and February—the crop was a good one and some excellent yields were obtained.

The crop matured during a period of dry weather when conditions for harvesting were excellent.

Damage caused by the army worm was much less than in former years, but in one locality in Naitasiri District complete losses were sustained.

A serious factor adversely affecting rice production is the prevalance of weeds—especially of Muraina grass (*Ischæmum rugosum*) which has spread rapidly in recent years and now infests much valuable rice land. In several cases this weed had completely smothered the rice crop making it useless to harvest the latter.

Another weed complained of by growers was the tar weed (*Lythrum hyssopifolium*)—popularly known as "Navua grass."

A summary of records relating to the thirteen local varieties grown is given in the following table:—

TABLE II—AREA AND YIELDS OF LOCAL VARIETIES (TAILEVU AND NAITASIRI).

| Variety. | Growers. | Area. | Average. area. | Average yield. per acre. | Remarks. |
|---|---|---|---|---|---|
| | | acres. | acres. | lb. | |
| China Patna .. .. | 741 | 925 | 1·25 | 2,520 | |
| Serea Patna .. .. | 95 | 142·5 | 1.5 | 1,680 | |
| Motka .. .. .. | 46 | 80·5 | 1·75 | 2·560 | |
| Karia Patna .. .. | 44 | 51·0 | 1·16 | 1,900 | |
| Lalka Serea .. .. | 19 | 43·8 | 1·3 | 2,110 | |
| Rewa Patna .. .. | 20 | 19·8 | ·99 | 1,960 | |
| New Guinea .. .. | 5 | 4·1 | ·80 | 1,680 | |
| Motmuria . .. .. | 5 | 3·9 | ·78 | 1,400 | |
| Chetwa .. .. .. | 10 | 6·3 | ·63 | 1,540 | (Heavy wind damage). |
| Sonacalif . .. .. | 2 | 2·0 | 1·00 | 1,540 | |
| Barmasia . .. .. | 1 | ·15 | ·15 | 1,360 | |
| Basmati .. .. .. | 2 | 2·3 | 1·15 | 1,470 | (Wind damage heavy). |
| Makunchus .. ... | 1 | 1·0 | 1·00 | 1·680 | |
| Total .. | 991 | 1,281·35 | Average yield 1,800 lb of padi per acre. | | |

Of the above area, 49 Fijian growers cultivated 77 acres (4 varieties)—the balance being grown by Indians.

It will be noted that the Patna padi types are most popular—comprising 92·3 per cent of the total area cultivated. This is possibly due to the fact that they mature early (May and June) and may be harvested before cane cutting commences.

China Patna withstands wind and rain better than other varieties and lodging is not heavy and the grain is also whiter than other varieties.

Motka (80·5 acres) represents only six per cent of the total; and the area (two acres) under Sonacalif (upland) variety is insignificant. Both these varieties deserve more attention in the Division; as excellent yields result from good cultivation.

New Guinea variety is a comparatively recent arrival in the Division but is rapidly gaining in popularity as it may be grown all the year round and is therefore in demand when climatic conditions (as lack of rainfall in November and December) interferes with the planting out of other varieties.

For the year 1941–42 season the estimated area for this variety is 60 acres.

Rewa Patna also is tending to take the place of China Patna as it matures earlier.

REFERENCES.

(1) Parham, B. E.—1939. *Agric. Journal* Fiji, Vol. 10, No. 3, pp. 73–75
(2) Parham, B. E. and Ramnath, B.—1939. Ibid. Vol. 10, No. 3, pp. 80–81.

## THE VITAMINS.

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### Introduction.

In the opening article of this series the Director of Medical Services dealt with the general problem of nutrition and in his article he made reference to the part played by the vitamins in the maintenance of normal health. Subsequent writers have dealt with nutrition and disease in the wider sense and practical methods to be observed in the preservation and preparation of food in order to retain the maximum of nutritional efficiency. The present article is concerned in a little more detail with the accessory food factors which are known as the vitamins and in this article I shall endeavour to give a brief account of the properties of these substances, the way in which they are supposed to act in the maintenance of normal health, the daily requirement and the foods in which they occur with particular reference where possible to foods available in Fiji.

Vitamins may be defined as organic substances which must be supplied in the diets of animals or synthesised in animals from essential products supplied by the diet and their purposes appears to be the control and co-ordination of specific and vital body processes. The vitamins are therefore definite nutritive substances but the remarkable fact is that the amounts required to maintain these vital processes is relatively small in comparison with the amounts of the flesh builders, energy givers and minerals which we require for normal health.

At the present moment something like fifteen vitamins have been recognized and of these the chemical nature of six has been determined and five have been synthesised in the chemical laboratory. Of the fifteen vitamins six play a definite part in human nutrition and it is believed that two others are also essential. The remainder are important in animal nutrition only.

It is not possible in a brief article such as this to deal with all the vitamins essential to human nutrition therefore I shall confine my attention to the four better known ones—namely vitamins A, B1, C and D.

I do not propose to deal in detail with the historical steps through which the vitamins were discovered. It will be sufficient to indicate to you that two fields of work combined into what the American, McCollum, the discoverer of Vitamin A, has called the newer knowledge of nutrition. These two fields of work were firstly a study of certain specific diseases called beriberi and scurvy and secondly, the attempt to nourish animals on synthetic diets composed of the known food components in the purified state.

The term "vitamin" was coined by Funk of London University as a result of an attempt to isolate from food the substance that prevented the disease beriberi. Subsequently the term has been retained and with a prefix such as A.B.C., etc., has been used to describe the various specific substances, lack of which are the cause of specific ailments. The terms A.B.C., etc., simply meant that a specific substance was recognised but that the nature of the substance was not known at the time. Within recent years and with dramatic rapidity, the vitamins are now being purified, and definitely isolated and even produced synthetically in the laboratory. This of course makes it possible to study in much greater detail the part they play in fundamental and in many cases obscure life processes and further their effects in preventing diseases due to faulty diet. Here then are the principal facts known about Vitamins A, B1, C and D.

## Vitamin A.

*Discovery.*—Thirty years ago it was found impossible to rear young animals on diets consisting of purified proteins, lard starch and salts in place of the natural foods. Addition of skim milk to the diet prolonged the lives of animals but even with this addition, after a period the animals died with a disease of the eyes. If a part of the lard is replaced by butter, and whey is also added, the animals live a normal life. The substance supplied by the butter fat is vitamin A and carotene, the latter substance being converted into vitamin A in the body.

*Nature of Vitamin A.*—At least five different substances in natural food can supply vitamin A to the body and the other is vitamin A itself. Under the microscope the four pigments known as the carotenes appear as beautiful orange yellow needles. Yellow and leafy green vegetables are rich sources of the carotenes and a rough measure of their amounts in food is given by the intensity of the colouring. Vitamin A itself is not highly coloured and is a thick pale liquid which has been isolated from different kinds of fish liver-oils. Most natural fatty food products of animal origin contain some vitamin A, but the fish liver-oils, particularly halibut and cod, are the richest sources.

*Function of Vitamin A.*—Human beings and animals store vitamin A in their livers (about 90 per cent of the total is so stored). These stores in the liver are called upon when the diet is deficient in vitamin A. When animals are fed on a diet deficient in vitamin A they begin to loose weight and then develop a series of eye conditions leading ultimately to blindness and death. In experiments with white rats on foodstuffs deficient in carotene or vitamin A the results of the deficiency can be noted in 21 days. Many of the conditions noted in experimental animals are found in humans, with varying severity, on low vitamin A diets and although it is not usual now-a-days to find gross deficiency conditions, such conditions did appear among the children of Denmark during the last war as a result of the extensive export of dairy products with substitution at home of cheaper substitutes. Medical opinion does not appear to support the theory that vitamin A in a concentrated form prevents certain infections but there are grounds for the belief that in cases of vitamin A deficiency there is a lowered resistance to infections.

*Distribution in Food.*—Vitamin A as such occurs only in food of animal origin; the vitamin A value of plant food is due to the presence of carotene pigments which, as we have stated above, are changed to vitamin A in the liver and stored as such. The four carotenes which are so converted are known as pro-vitamin A and I now give you a list of foods in which these products occur.

FOOD SOURCE OF VITAMIN A AND PRO-VITAMIN A.

| Type of food. | Excellent. | Good. |
|---|---|---|
| Animal Products .. .. | Fish liver oils, Egg yolk, Butter, Cheese, Fish roe. | Cream, Kidney, Oysters, Whole milk, Red salmon. |
| Vegetables .. .. .. | Spinach, Dalo tops, Green lettuce, Water-cress, Chinese cabbage, Beet greens, Carrots, Yellow squash, Red tomatoes, Green peas, Green beans. | Green asparagus, Brussel sprouts, Yellow tomatoes, Sweet potatoes. |
| Fruits .. .. .. .. | Apricots, Pawpaw, Mangoes, Prunes, Yellow peaches. | Avocados, Guavas, Bananas, Pineapples, Deep yellow juice oranges, Dates, Olives. |
| Cereals . .. .. .. | ..... | Yellow corn meal. |

*Requirements.*—As with the other vitamins there is still some uncertainty as to the minimum quantity required to maintain normal health. Many factors must be taken into consideration such as the state of health of the individual and individual peculiarities. Moreover there are so many variable factors that cannot be pinned down with scientific exactitude in animal experimentation. I will not bore you with the many scientific arguments adduced in terms of units as a result of scientific enquiries based mainly on biological methods but will summarise the modern views in an essentially practical manner.

For children between the ages of two and fourteen a liberal amount of vitamin A will be provided if their daily food contains about a quart of whole milk, in addition to an egg or egg yolk, servings of green leafy vegetables and of butter suitable to the size of the child, and a half teaspoonful of cod-liver oil or other fish oil.

For a normal adult it is sufficient to take a daily allowance of a pint of whole milk, one egg, one third ounce of butter and an average serving of leafy green or yellow vegetables. It is not necessary to include exactly these articles of diet since from the table given above there are several alternatives, however the group just mentioned offers a combination which supplies other nutritional essentials in very desirable allowances.

## Vitamin B1.

What used to be known as vitamin B was found to be a complex of several vitamins. One of these is called vitamin B1, another is vitamin G or riboflavin. The old vitamin B is now referred to as the vitamin B complex and contains several specific dietary essentials some of which I shall refer to later.

Vitamin B1 is an essential dietary substance which cannot be synthesised in the normal processes of the human body and must therefore be supplied in the diet. This substance is required for the normal growth of all species of animals, of yeasts and moulds, and of the higher plants which have the ability to manufacture and store it in the seed principally in the germ.

*Nature of Vitamin B*1.—It was not until 1936, forty years after vitamin B1 deficiency was produced in experimental animals that the structure of this substance was determined by organic chemists and the material synthesised in the laboratory by the American Chemist R. R. Williams. This crystalline vitamin, in a pure form, called thiamin chloride in America and aneurin in Europe is now available at low cost. Like other members of the B complex this vitamin is soluble in water, insoluble in fat solvents, and depending upon the alkalinity or acidity of the medium, is destroyed by heat in the presence of moisture. The destruction is rapid and complete in alkaline solution, for example cooking vegetable with soda; in acid solution the vitamin is somewhat more stable. If reasonable care is exercised in the preparation, processing or preservation of food (by methods indicated to you in a previous article in this series), important amounts of vitamin B1 need not be lost.

*Function of Vitamin B*1.—As previous writers have informed you a lack of this vitamin in the diet causes the human deficiency disease beriberi, and you are no doubt aware that its high prevalence among Orientals is due to eating polished rice as the principal article of their diet. However as one of our writers pointed out there are many degrees of deficiency causing less well defined symptoms such as are characteristic of the severe and easily recognized forms of the disease. This disease can of course be cured by the administration of concentrates or pure crystalline B1, followed by a return to a balanced diet. Vitamin B1 is necessary for the well being of every

living cell since its main function in the body is concerned with the breakdown of those foods which supply energy. The manner in which this process was unravelled constitutes one of the most brilliant pieces of work in the fields of biochemistry and physiology, but I am afraid that time does not permit me to discuss it here. There is however, one important point that should be mentioned in passing and that is that when the diet is higher in fat, less vitamin B1 is required. The chain of chemical events leading to production of energy from fats in the body does not directly involve vitamin B1. The high carbohydrate diets common with the Fijian and Indian community is therefore wasteful of vitamin B1 and is a further argument for the inclusion of more fat in the diet of the Fijian and Indian as advocated by the Nutrition Committee.

*Distribution in Foods.*—In the days before modern machinery led to fine milling and refining of food, our grandmothers unknowingly were blessed with more vitamin B1 in their diets. The polishings from rice and the bran and germ portions of grain are among the richest natural sources of this vitamin. Besides the rich plant sources, i.e. whole grains, legumes, nuts, vitamin B1 occurs in many animal and marine foods. For some curious and as yet unexplained reason lean pork is an exceptionally good source. In the following table is included a list of foods containing vitamin B1:—

| Type of food. | Excellent. | Good. | Fair. |
|---|---|---|---|
| Animal Products . | Lean pork, Chicken, Kidney, Liver. | Egg yolk, Brains, Lean beef, Lean Mutton, Fish roe, Codfish, Sardines. | Fresh milk. (whole or skim). |
| Vegetables . .. | Green peas, Certain beans. | Potatoes, Sweet-corn, Sweet-potatoes, Cauliflower, Cabbage, Spinach, Cress, Lettuce, Onions, Tomatoes, Beans, Carrots, Parsnips, Beet. | Turnips, Broccoli, Kohlrabi, Egg plant. |
| Fruits .. .. | ..... | Prunes, Avocados, Pineapples, Oranges, Grapefruit, Figs, Tangarines, Plums, Pears, Apples. | Bananas, Watermelon. |
| Seeds .. .. | Wheat, Corn and Rye germs, Rice-polishings, Wheat Bran, Oats, Whole grain wheat, Rye, Barley, Brown rice, Peanuts, Cowpeas, Soyabeans, Dried peas. | Hazelnuts, Brazil nuts, Walnuts. | .... |

*Human requirements of Vitamin B1.*—The human body is unable to store large quantities of vitamin B1 and it is therefore necessary to maintain a constant supply in the diet. As a result of many studies and approaching the problem from several angles it is believed that the normal human daily requirement lies somewhere between 200 and 700 International Units, that is about 0·6 to 2·1 milligrams of the pure vitamin. Selecting from the table above the following foods would supply the requisite vitamin intake. An average good helping of lean beef, sweet potatoes, green peas and carrots with two slices of wholemeal bread, followed by a banana or three slices of pineapple. This diet would give approximately 350 International Units and would probably be more than sufficient as far as vitamin B1 is concerned.

Of course this is not the only combination of foods that could be used to supply the necessary B1 vitamin and there are other considerations in choosing a suitable diet. I merely quote this combination in order to give you an idea of what International Units of vitamin B1 mean in terms of food.

## Vitamin C.

In the 13th Century scurvy occurred among the Crusaders and in 1520 the Austrian surgeon Kramer pointed out that this disease could be cured by eating limes, lemons and oranges. In 1795 lime juice was introduced in the British Navy and as a result this scourge of long sea voyages and sea diets was effectively prevented. About 47 years ago an American, T. Smith, showed that guinea pigs fed on certain diets developed a peculiar disease which, ten years later some Norwegian investigators showed to be similar to scurvy or the disease prevalent among sailors on long voyages and further this disease could be cured (in guinea pigs) by cabbage or more spectacularly by orange juice in a manner similar to the cure of the human condition. These findings led to the recognition of scurvy as a vitamin deficiency disease but 25 more years elapsed before this, the third vitamin to be recognized and called vitamin C, was finally separated from food, identified, as a chemical compound already known from other sources, and manufactured for use in the laboratory and hospital.

*Nature of vitamin C.*—Vitamin C is now synthesised in ton lots and can be purchased from any pharmacy as small white tablets called cevitamic acid, or ascorbic acid. The material is slightly acid in taste and under the right conditions can combine either with oxygen or hydrogen. Now the oxidised from of the vitamin is of no value in the prevention of scurvy, so that when foods are exposed too long to the air, the vitamin C contained in them is oxidised and the food is of no further value as a source of the vitamin. In living animal tissue the vitamin is prevented from combining with oxygen by another substance called an enzyme. This inhibiting agent is very essential for the proper functioning of the vitamin because once it is oxidised it cannot be changed back to the active form.

*Function of vitamin C.*—At the present time almost eight years after the identification of the vitamin there is still some uncertainty as to how it acts in the human body and how much of it is needed by people of different ages. The gross symptoms of scurvy, such as soreness and stiffness of the joints, swelling and bleeding of the gums with loosening of the teeth, and other symptoms are now seldom seen, but there are many vague symptoms of ill-health such as restlessness and irritability in children and a run-down feeling in adults which is ascribed by some medical authorities to vitamin C lack. From a careful study of guinea pigs suffering from scurvy it has been found that certain changes take place around the cells in tissues such as the marrow of the bones, the dentin that composes the principal mass of the teeth and various connective tissues throughout the body. Normally these cells are surrounded by a stiff jelly-like material which in animals deprived of vitamin C becomes a thin watery fluid incapable of supporting the cells. On supplying vitamin C the jelly like normal state is restored. This same state of affairs probably occurs in humans suffering from scurvy, but there are still many things that cannot be satisfactorily explained, such as, the slow healing of wounds, and the greater demand for vitamin C when animals are suffering from certain infectious diseases notably tuberculosis. Recent work would appear to indicate that the vitamin does actually assist in the combating of the organisms producing the infection but confirmation of this work is necessary.

*Distribution in food.*—From careful enquiries it appears that the optimum amounts of vitamin C required to produce saturation are for a child, daily about 50 milligrams and for an adult 100 miligrams, that is, in terms of one of the richest sources, about half a cupful of orange juice for a child and a whole cupful of orange juice for an adult. Some authorities even go so far as to state that the daily allowance for a child should be gradually increased to that of the adult.

In a recent paper of the *Agricultural Journal*, Fiji, I have recorded the results of some determinations of vitamin C contents of our local fruits and vegetables and in the following table I include these determinations together with others recorded in the literature.

| Type of food. | Excellent. | Good. |
|---|---|---|
| Animal Products ... .. | Liver, Brains. | Kidney. |
| Vegetables .. .. .. | Water-cress, Spinach, Sweet peppers, Kohlrabi, Cauliflower, Cabbages, Tomatoes, Green peas, Radishes, Broccoli. | Cucumbers, Parsnips, Sweet potatoes, Green beans, Onions. |
| Fruits .. .. .. .. | Guavas, Mangoes, Oranges, Lemons, Grapefruits. | Pineapples, Pawpaw, Bananas, Avocados pears, Watermelon. |
| Seeds .. .. .. .. | Sprouted seeds. | ..... |

The results of the determinations of vitamin C in our local fruits and vegetables indicate that our local products compare very favourably in values with similar foodstuffs recorded for other countries.

## Vitamin D.

*Discovery.*—It was Sir Frederick Gowland Hopkins, the eminent British Biochemist, who first pointed out that rickets was connected with some obscure accessory dietary factor and Mellanby made the first experimental demonstration of rickets in dogs by feeding a diet deficient in fat soluble vitamin. Unfortunately Mellanby came to the conclusion that the vitamin concerned was vitamin A and it was left to McCollum of Johns Hopkins University, United States of America, to demonstrate that a distinct vitamin which he called vitamin D, was concerned with rickets and that this vitamin occurred with vitamin A in cod-liver oil. The absence of this vitamin in the diet of the young was definitely connected with the development of rickets but as we shall see later vitamin D lack is not alone responsible for the disease.

*Nature of vitamin D.*—Vitamin D is a fat soluble substance and we now know that apart from the vitamin itself which occurs in the liver oils of several fish, it can be made from a substance called ergosterol present in ergot, yeast and in animal tissues (including man) by a process called irradiation using ultra-violet light. Now this ultra-violet light also occurs to a certain extent in sunlight, depending on several factors, such as the altitude of the sun, latitude, humidity, etc., Under favourable conditions, such as must obtain in Fiji during a great part of the year the ergosterol present in our skins can become irradiated and produce the vitamin. This effect of irradiation is decreased in the case of negroes and certain dark-skinned white races so that unless they receive additional exposure to sunlight their vitamin D requirement is greater than that of lighter skinned

people. It is necessary to point out however that over-sunning can be dangerous with certain individuals and care should be taken in this respect. Several products are produced from ergosterol by irradiation with ultra-violet light and one of these, called calciferol, is a white crystalline substance with definite vitamin activity. The vitamin D which occurs in fish-liver oils is slightly different to this calciferol and has been made artificially from another substance related to cholesterol which also occurs in the human body.

*Function of Vitamin D.*—You are all familiar no doubt with the condition which is called rickets and which is common in large manufacturing smoke covered cities. It is essentially a disease of children and in 1928 a survey of the London Elementary School Children showed that 87 per cent gave evidence of having had some degree of rickets. A recent survey of the city of Manchester showed that 9·2 per cent of the children of that city had pronounced rickets. With the discovery of the vitamin associated with the prevention of this disease it was hoped that by plenty of sunlight and preferably by the inclusion in the diet of good food containing the vitamin, rickets would soon be a disease of the past. However difficulties soon cropped up. It was found that even with plenty of the vitamin in the diet experimental animals would sometimes develop rickets. This was rather baffling and it took some time before the cause was determined. It was found that vitamin D was but one factor concerned in rickets. There were two more, namely (1) calcium and phosphorus in the diet must be in sufficient amount and (2) the ratio of calcium to phosphorus must be within well defined limits. We can conclude this section by stating that the function of vitamin D in the body is concerned in the proper using of calcium and phosphorus and is therefore concerned in the proper formation of bones and teeth.

*Distribution in Food.*—The distribution of vitamin D appears to be limited to a few animal and marine foods and the evidence for its occurrence in plant foods is not convincing. Cod-liver oil was considered to be the richest source but it is now known that halibut, tuna, salmon and swordfish liver-oils contain greater quantities. Apart from foods which have been enriched by artificial ultra-violet light and the direct effect of sunlight on the animal body, the following foods are sources of vitamin D:—

Excellent sources—Fish-liver oils and egg yolk from hens on a high vitamin diet.
Good sources—Salmon, sardines, eggs and butter.
Small amounts—Liver, cream, whole milk and oysters.

*Requirements.*—I do not propose to bore you with the many scientific arguments in regard to the daily requirements of vitamin D. It would appear however that the requirements of vitamin D for children lie somewhere between 300 and 800 United States Pharmacopœia Units, that is, between one and three teaspoonfuls of codliver oil. This means that children must receive from all sources, sunlight and food, a quantity of vitamin D equal to that contained in one to three teaspoonfuls of official codliver oil. The requirement for adults under normal conditions is not known with certainty.

## Conclusion.

As I have stated above it has not been possible for me to cover the whole field of the vitamins in the course of this short article. For example we have not been able to refer to the antidermatis factor riboflavin or as it is named vitamin G. There are still many more accessory food factors which are of direct concern in the feeding of animals and therefore

of indirect concern to human beings dependent on animal foods; however I think that you will agree that the field of the vitamins is a fascinating one and results obtained represent one of the most brilliant and far reaching achievements of the twentieth century. The work has been performed by a team consisting of the biochemist, organic chemist, medical shientist and last, but not least, the little white rat, guinea pig and dog. To these pets of the biochemical and physiological laboratories the human race owes a debt it can never repay for without them nutrition studies could not have gone far.

Within the last few years with the isolation, purification and in some cases the synthesis of the vitamins the chemist has had an opportunity to devise chemical and physical methods for the determination of the vitamin contents of foods and biological materials. As a result it is now possible to determine vitamins A, B1, C, Nicotinic acid, Riboflavin and others by physical and chemical means with an accuracy greater than that possible by biochemical methods and therefore the time is not far distant when the food laws of enlightened countries will include legal definitions of vitamin content in the stable foods and the determination of Vitamins in foods will become a routine duty of Government Analysts.

In preparing this article I have borrowed extensively from original literature and although it is not possible for me to acknowledge all sources of information my particular indebtedness is due to the publications by Fixen and Roscoe—" Tables of the Vimatin Content of Human and Animal Foods " and to the United States Department of Agriculture Year Book, 1939, " Food and Life."

## WATER-CONTROL METHODS FOR SMALL HOLDERS.

By
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THE Department of Agriculture has done much work over the period of sixteen years on the trial, importation, and distribution of new varieties of rice. In some cases the hall-mark of approval by Indian growers has been the renaming of favoured varieties so that field officers often find a newly reported superior padi to be just an old friend under a new name.

In the course of this work it has become obvious that in Fiji rice is generally treated as a rain crop. Almost every year one hears of an abnormal season damaging the rice crop. To define what exactly constitutes a normal season is an unsolved problem and rain crops must always be a gamble.

In the following notes an attempt is made to give concise information on methods of water control actually carried out in Fiji by the writer and within the means of the smallest agriculturist.

The introduction of Golden Californian Rice and its popularization under the name of " Sonacalif " has done much by providing a dry land rice less affected by climate and season than many other varieties but it does not take the place of the higher yielding and to many more palatable wet padis.

Increased production of rice is urgent as a war effort and to increase the yield of existing fields promises quicker results than simply to multiply growers and acreage. The selection and distribution of seed of higher yielding strains has its limitations. The direct irrigation of padi fields and generally improved control of water promises speediest results.

Both Indians and Fijians can show individual examples of successful water control for agricultural purposes. In rare cases Indians have blocked

streams with low temporary dams so as to irrigate small areas; and from ancient times the Fijians have been expert in the art of irrigating terraced hill-sides. For instance in 1933 the writer was so impressed by the extent of the ancient irrigated terraces for dalo in Navatusila, Colo North, that he had some terraces ploughed and sown with padi. In many parts of Viti Levu and of Vanua Levu the writer has seen admirable efforts by Indians in the banking of padi fields so as to retain surface water as long as possible, but the crops are still dependent on rain.

Where Indians have attempted irrigation the ephemeral nature of the dams favours the supply of water only in particularly convenient localities and over small areas. The Fijians were, and in some parts are, still very expert in irrigation works including permanent dams, water-races, and even the piping by bamboos of water across rock faces, but though terraced areas literally cover miles of hillsides the methods used have meant immense expenditure of labour for the watering of narrow if numerous gardens.

As regards terraces and banks (bunds) the modern art of contouring is an advance on the old disregard of inequalities in the land. A bank to hold water on land requires less labour if built around the natural curve of the land. Straight lines means high instable banks across depressions. In practice at the Waimaro Fijian Settlement the whole padi area has been banked with the plough following the contours. The resulting fields are of irregular shape but that has no practical disadvantage in rice growing.

The irrigation of the area depends on a dam across a small stream and on a water-race or channel which was given the minimum fall practicable so as to serve the largest area possible. In this contouring again was of service as in practice after a contour line has been marked out it is simple to diverge just enough from the line in digging the channel to allow flow of the water. The setting out of contours can be done with home-made apparatus but it is simplest to have the advice of the local Agricultural Officer.

The dam at Waimaro has withstood all the storms of 1941. It was built of logs fixed at right angles across the stream by the ends being buried in trenches cut in the banks. General instructions for the construction of such dams are: to limit the height of a dam to four feet, to select a narrow part of the stream where the banks are high, to level the bed of the stream and to slope the banks. On the levelled bed logs are placed up and down stream to form an apron across which the logs forming the dam are placed. What is termed a " notch " is made in the dam by leaving a gap in the upper part of the dam by building out from either bank with short logs. Considering the " cloudbursts " common in Fiji there is little object in utilizing expensive materials in such dams and if durable timbers are not at hand it is reasonable to use any trees of suitable size. Many so-called " softwoods " are quite durable under water. The writer used the largest trees at hand and these were drawn into position by a pair of bullocks but it is possible to use even saplings tied into bundles with wire. It is most important to fix posts in the bed of the stream at intervals along both sides of the dam and in pairs so that each pair may be lashed together across the top of the dam. Such posts should also secure the dam timbers where buried in the banks of the stream. If the dam is placed at an angle across the stream other than at right angles to the stream there is danger that when in flood the stream may be diverted to form a new channel where not wanted.

At Waimaro the dam was placed opposite a low rise close to the stream and the water-race was cut through the high ground and a sliding gate fixed in the cutting. During floods the gate is shut and the high ground protects the race from damage by a torrent of water.

To turn to another aspect of water-control it is paradoxically true that one finds rice planting limited by land being too wet as well as too dry. At Dobuilevu in Ra on a number of holdings there is much boggy land, but as this is difficult to plough rice has been planted on the surrounding dry land with resulting serious losses from drought. This problem has been tackled by the cutting of a drain across the upper margin of the boggy land so as to intercept the underground flow. These swamps are on hill-sides so it has been possible to continue the drain with the minimum of fall around the slopes so that the maximum area can be irrigated from the ditch as required. Subsequent to carrying out this work the writer was interested to read the following:—

> " Where open drains are employed it is imperative to cut them across the highest points at which spring, seepage, or surface water commences to saturate the soil. If the source of the water can be tapped in this way the open drain will have the effect of de-watering a considerable area of land on its lower side. But to do this it must be sufficiently deep to bottom on the water-impervious sub-soil, and must run as nearly as possible across, or at right angles to, the natural flow of the seepage. Only sufficient fall should be allowed to keep the drainage water flowing steadily to the outlet. Too much fall will scour out the bottom and sides and cause endless trouble with caving, while a drain with a steep fall will also drain a smaller area than one with a gradual fall."(1)

> In reclaiming swamp land for rice planting it is certain that " buried drains ", will be useful also, and the above writer's comments are: " the dug drains can be filled with material which will allow the water to flow freely, but which will prevent the earth filling from blocking the drain. Tightly tied bundles of scrub or light poles are effective and will last for many years where they do not come in contact with the air. In some district pungas are available from near-by native bush and these if placed with the heads in the direction of the water flow, will give good drainage for more than a lifetime."(2) It may be remarked that at the Sigatoka Experimental Station good results were obtained by using cotton stalks as filling. The " punga " of New Zealand resembles the " balabala " fern of Fiji. On one Indian holding in Vanua Levu stems of " balawa " (*Pandanus* sp.) have been used to good purpose as drain pipes.

The above is necessarily a bare outline of work done and the farms at Waimaro and at Dobuilevu exist for the " demonstration " of methods to those interested. Work at these farms is limited as has been said to such practices as are within the means of the small holder but simple labour-saving devices are improvised. At Waimaro a V-drag and a long-winged terracing plough have been found useful. The drag consists of two hardwood beams fixed at an angle of 33 degrees. One timber is eight feet long and one four feet long. The terracing-plough was improvised from a " Victory " plough by replacing the mould-board with a piece of 9 in. x 1 in. damanu two feet six inches in length. The utility in both of these is in finishing off banks thrown up by the plough and in finishing irrigation furrows. The construction and use of these and other implements is thoroughly discussed by Ayres.(3)

REFERENCES.

(1) and (2) Brereton, H. 1941.—" Draining Dairy Farms." in " The Weekly News." Auckland, N.Z., No. 4059, Sept. 10th.
(3) Ayres, Q. C. 1936.—" Soil Erosion and its Control." McGraw-Hill Book Coy., Inc., New York & London.

## DEPARTMENT OF AGRICULTURE, FIJI.

## DIVISION OF ENTOMOLOGY.

# ANNUAL REPORT FOR 1941.

By
R. J. A. W. LEVER, B.Sc. (Hons.), D.I.C., A.I.C.T.A., F.L.S.
Entomologist.

### 1. Green Vegetable Bug.

*Nezara viridula* L. was found to have extended its range from Viti Levu and Vanua Levu to Taveuni and Rabi. In March a colony of the egg parasite *Microphanurus basalis* Woll. was kindly sent by the Government Entomologist, New South Wales, and 11,000 individuals were liberated locally in the remaining nine months of the year, and 350 sent to Tonga, one consignment going by plane. The life cycle of the parasite varied from 8½ days in December (79·7°F. mean temperature) to 14½ days in August (72·7°).

### 2. Quarantine.

Owing to the recent arrival of the cabbage white butterfly (*Pieris rapæ* L.) in Australia it was decided to prohibit the importation into the Colony of crucifers from that country.

Cuttings, orchids, fruits, flowers and nuts from the British Solomon Islands, New Caledonia, Gilbert Islands and Rotuma were examined for insect pests and a new scale insect was intercepted on a young fig tree from the Gilberts. Seed cotton from the New Hebrides was also examined but only *Oryzæphilus* and *Tribolium* were present; both of these beetles occur already in Fiji. Book lice (Pscoptera) were found in some pressed flowers sent through the post from India.

### 3. Beneficial Insects.

The breeding and liberation of the Indian fruit fly parasite *Dirhinus* was continued by the Native Laboratory Attendants and a total of nearly 42,000 was released compared with 34,350 in 1940. A colony of the lantana bug *Teleonemia scrupulosa* Stal. was sent to Lodoni and *Liothrips urichi* Karney to Gau for control of *Clidemia hirta*.

### 4. Miscellaneous Pests.

*Agonoxena argaula* Meyr. on coconut leaves; *Prodenia litura* F. on *Colocasia*; *Heliothis armigera* (Hbn.) in maize cobs; *Cirphis unipuncta* Haw. on rice and sugar leaves; *Achæa janata* L. on rose leaves; *Othreis fullonica* L. on citrus fruits; *Polydesma umbricola* Boisd. on leaves of *Enterolobium saman* Prain (rain tree); *Argyna astrea* Drury on leaves and pods of *Crotalaria saltiana*; *Crocidolomia binotalis* Zell. on cabbage leaves; *Adoxophyes fasciculana* Wlk. on tea; *Stictoptera bisexualis* on leaves of *Calophyllum inophyllum*; *Xyleborus rameus* Schedl. in seeds of *Podocarpus vitiensis*; *Xylothrips religiosus* Boisd. in posts of *Cymometra grandiflora*; *Dinoderus minutus* F. in bamboo stems; *Crossotarsus saundersi* Chap. in rubber trees, posts of *Cynometra* and *Sideroxylon* logs; *Catorama herbarium* Gorh. in books; *Adoretus versutus* Har. on rose leaves; *Pachymerus gonager* F. in seeds of *Tamarindus indica*; *Lasioderma serricorne* L. in cheroots; *Necrobia rufipes* de Geer in copra sacks; *Cimex hemiptera* F. in barracks; *Lygus muiri* Poppius in dahlia flowers and *Sogata furcifera* Horv. on rice leaves. The white ant *Kalotermes repandus* Hill. was found in Oregon timber in a house and reported from growing trunks of mangrove *Bruguiera gymnorhiza*. The dog tick, *Rhipicephalus sanguineus* Latr., in floor boards; some control was given by application of paradichlorobenzene in paraffin.

5. Coconut Insects.

A short tour was made to Colo East where *Levuana iridescens* B.B. was reported but climbers succeeded in obtaining only three larvæ of this moth which was doing but little damage. The small coconut weevil *Diocalandra taitensis* Guer. causes next to no primary injury to young nuts. A visit to Rabe showed that neither *Levuana* nor *Promecotheca reichei* Baly were present on palms in that island which, however, had attacks by the Phasmid *Græffea cocophaga* Newp.

6. General.

An exchange of economic insects was arranged with the Plant Diseases Institute of Auckland, New Zealand; the citrus moth *Cryptoblabes plagioleuca* Turn. was identified from Rarotonga as well as a collection of economic insects from Tonga to which group *Microphanurus* was sent; an entomological exhibit was sent to the Royal Agricultural Show, Sydney, New South Wales; Miss E. Lindsay of the Department of Agriculture, Melbourne, studied the local Thysanura and Mr. N. L. H. Krauss, of the Department of Quarantine and Forestry, Hawaii, collected insects on Viti Levu and Kadavu. Besides acting as Editor of the *Agricultural Journal*, the Entomologist supervised petrol rationing. Military duties prevented touring and only one journey was made away from Viti Levu. Measures were given for control of cockroaches, aphis, mealy bugs, scales, caterpillars, mosquitoes and mites. An article on cotton insects was prepared for the Empire Cotton Growing Corporation. Insects were sent to London and Honolulu for identification, a few collections being lost by enemy action in the Atlantic. Thanks are due to the Director of the Imperial Institute of Entomology for determinations made under war conditions. Nineteen original articles were written for the *Agricultural Journal* including a review of the pests likely to be introduced by transoceanic planes. The good work performed by the native staff of the Laboratory is placed on record.

## ENTOMOLOGICAL NOTES.

By

R. J. A. W. LEVER, B.Sc., D.I.C., A.I.C.T.A., F.L.S.

### 1. A SHOT-HOLE BORER ATTACKING RUBBER TREES.

In a recent issue of this Journal (1) mention was made of damage by *Crossotarsus saundersi* Chap. to branches of avocado pear, grapefruit and *Sideroxylon* and also to logs of *Cynometra*. In September, 1941, the writer found this beetle boring in the bark of a single healthy rubber tree with a girth of three and a half feet at a height of five feet from the ground. No penetration had been made beyond the bark as all had been killed by the latex, twenty-five dead beetles being counted in a six-inch square at a height of five feet. Surrounding trees were searched in vain for attacks.

The interest of this observation is that in Ceylon the closely related *C. minax* Wlk. has been found(2) to construct its galleries right across the trunk of rubber trees and in that island the local *C. saundersi* is recorded from a diseased mango tree, the attack resulting in " a profuse exudation of calcium oxalate from the bark." No material, such as tar or carbolineum, had been painted on the trunk of rubber to prevent canker in the case of the Fijian example though this had been done in Ceylon on mango.

REFERENCES.

(1) Lever, R. J. A. W.—1941. *Agric. Journ.* Fiji. Vol. 12, No. 3, Sept.
(2) Speyer, E. R.—1923. *Bull. Entom. Resch.* Vol. 14, No. 1, July.

## 2. THE TAMARIND BEETLE IN THE DRY ZONE.

The largest of the so-called pea or bean weevils found in Fiji is *Pachymerus gonager* (F.) a greyish-brown beetle ¼ inch or 6 mm. long with inflated femora. In November, 1941, this insect was found boring inside the very hard seeds of the tamarind (*Tamarindus indica* L.) at Natabua in the dry zone where the rainfall averages seventy inches. Although recorded from pods of *Acacia farnesiana* L.(1) and ripe seeds of *Bauhinia monandra* Kurz.(2), it has not been reported from tamarind before in Fiji. The larva tunnels within the stony seeds, which are invested in a sweetish, brown mucilage, coming to the surface at pupation to construct a parchment-like membrane. No parasites were reared though in Honolulu(3) the egg parasite *Uscana semifumipennis* Gir. and five larval ones control this insect in pods of *Prosopis juliflora* D.C. Associated with *Pachymerus* in Fiji were *Diocalandra* sp. and *Tribolium* sp., both being secondary.

REFERENCES.

(1) Veitch, R. and Greenwood, W., 1921—*Proc. Linn. Soc.* N.S.W. Vol. 46, Part 4.
(2) Greenwood, W., 1940—*Ibid.* Vol. 65, Parts 3–4.
(3) Swezey, O. H., 1928—*Journ. Econ. Entom.* Vol. 21, No. 5.

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## 3. THE GREEN VEGETABLE BUG AND ITS PARASITE.

In the issue of the Journal for September, 1940 (1), it was stated that a specimen of *Nezara viridula* L. var. *smaragdula* F. had been obtained from Buca Bay, Vanua Levu, the first known local record of this bug outside Viti Levu. Early in October, 1941, the writer visited Rabe and Taveuni and found this insect on beans: colonies of *Microphanurus basalis* Woll. were liberated in both islands.

The figures previously given (2) for duration of this parasite's life cycle in *Nezara* eggs have now been amplified and the range is from 8½ days in March and December (mean temperature 81·8° and 79·7°F. respectively) to 14·5 days in August (mean 72·7°). February is normally the hottest time of the year and it was found that the life cycle can be completed within eight days during that month.

The parasite has been recovered in the Suva area, egg clusters of the bug on tomato leaves being found parasitised in the field.

(1) Lever, R. J. A. W.—1940. *Agric. Journ.*, Fiji, Vol. 11, No. 3, Sept.
(2) Lever, R. J. A. W.—1941. *Ibid.*, Vol. 12, No. 2, June.

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## 4. THE NAME OF THE COTTON JASSID OR LEAFHOPPER.

The cotton jassid was first reported in Fiji in 1927 by R. R. Anson and generically identified in 1929 by the Imperial Institute of Entomology, London, as a species of *Empoasca*. From 1931 onwards, as explained previously (1) the writer has been trying to get specialists in England, India and Italy to describe it specifically but he met with no success until corresponding with Mr. J. W. Evans, Entomologist of the Department of Agriculture, Tasmania.

Last October the latter kindly provided the manuscript name of *E. quadripunctata* Evans which may be used pending publication late this year. The name is in allusion to the two black spots on each forewing of this yellow jassid in which females greatly outnumber the males.

(1) Lever, R. J. A. W.—1940. *Agric. Journ.* Fiji, Vol. 11, No. 1, March.

## 5. THE GIANT TOAD IN QUEENSLAND.

In a recent report* printed in Brisbane it is noted that the cane beetle pest *Lepidiota* is being consumed by the giant toad (*Bufo marinus* L.), introduced into Queensland in 1935. As many as 22 beetles were found in the stomach of one toad and, more important, it seems that the beetle borer (*Rhabdocnemis obscura* Boisd.) is being controlled in no small way by this amphibian.

The local representative of *Lepidiota* in cane fields is *Rhopæa* and *Adoretus versutus* Har. in the gardens while *Rhabdocnemis* is a well known sugar pest in Fiji. The usefulness of this toad, which was introduced here the year after it was brought to Australia, is therefore likely to increase as time goes on.

* Bell, A. F.—1941. 41st Annual Report of the Bureau of Sugar Experiment Stations, Queensland.

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## 6. THE BED BUG IN MELANESIA.

With larger numbers of military forces than usual in the Colony the question of the bed bug (*Cimex hemiptera* F.) crops up again and certain points may be appropriately mentioned in this Journal. All specimens sent from Fiji to the Imperial Institute of Entomology, London, have been identified as *Cimex hemiptera* F. with the exception of one specimen taken twenty years ago at Lautoka which was returned as *C. lectularius* L.

It is of interest to note than an American doctor with years of tropical experience recently stated (1) that Fiji does not possess bed bugs, white ants or snakes though bed bugs were recorded as being common in 1911 (2), as they certainly are to-day. As for white ants or termites there are six recorded species and three species of snakes. Incidentally Dr. Heiser's "native marsupial rat" of the cane fields is not native but introduced and is a true rodent and so could not be a marsupial.

In Jepson's paper recently referred to it is stated that the bed bug was probably originally introduced from India by the immigrants in the 'eighties but as the Fijian name for it is "kutu ni Tanna" or louse from Tanna (an island in the southern New Hebrides) it seems more likely to have been brought into Fiji in the 'sixties or 'seventies by Melanesians from those islands. This suggestion, however, conflicts with Buxton who states (3) that it is a recent introduction into the New Hebrides, which is surprising as it has been well established for years in the Solomon Islands to the north whence labourers also came to the Fijian cane fields in the 'sixties and onwards. Twelve years ago it did not accur in native houses in New Guinea (4).

Where cyanide fumigation cannot be carried out the use of one of the various proprietary sprays is recommended for walls and floors of barracks and native houses where wall paper does not have to be considered. The canvas next to the wooden framework of stretchers is a site where the bugs congregate in large numbers and so requires special treatment.

REFERENCES.

(1) Heiser, V.—1936. "A Doctor's Odyssey"—Messrs. Jonathan Cape.
(2) Jepson, F. P.—1911. Dept. Agric. Fiji, Council Paper No. 25.
(3) Buxton, P. A.—1927. "Researches in Polynesia and Melanesia", London.
China, W. E.—1930. "Insects of Samoa," Part 2, Fasc. 3.

# BOTANICAL NOTE.

## PLANT PROTECTION.

(Notes from the Pathological Laboratory—III.)

By

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### 1. Soft Rot of Jak-fruit (*Rhizopus artocarpi*).

In July, 1940, a severe soft rot of young female inflorescences of the Jak (*Artocarpus integer*) was noted on trees near Naduruloulou.

On these trees all the inflorescences (young fruits) were totally infected, the fungus forming a grey, later black, mass of dark sporangia surrounded by a lighter fringe of immature sporangiophores.

The infected parts decay rapidly and the whole fruit mummifies and drops off.

As recorded by Crisanto[1] the rot begins near the stem and takes four or five days to involve the whole surface of the fruit; and the infection appears to be independent of any mechanical injury.

This is the first record for Fiji of this disease of Jak-fruit; and the severity of the infection may be attributed to the low temperatures experienced at the time and to the climatic conditions of fine weather alternating with occasional light showers of rain.

### 2. White-Rust of Cruciferæ (*Albugo candida*).

During the same period specimens of China Cabbage grown by a Suva resident were sent in for examination. These were covered with discontinuous greyish white lesions on the stems and under surfaces of the leaves: and were unfit for use.

The casual organism is *Albugo candida*, a common pathogen on many members of the Cruciferæ in all parts of the world.

The trouble may be recognized readily by the white pustules, either forming isolated patches or coalescing to form continuous leasions in all parts of the plant. These patches are the fructifications of the fungus which are formed below the epidermis, later erupting to release the conidia. These latter are spherical bodies from which motile swarm spores are liberated and transferred to other plants in dew or rain.

The disease advances rapidly under favourable conditions of temperature and moisture; and the outbreak is regarded as due to cool weather experienced in Suva at that time.

The average maximum and minimum temperatures during June were 72°F. and 68°F. and during the first two weeks of July, 73°F. and 62°F. respectively. The optimum temperature for germination of *Albugo candida* spores is stated to be about 56°F. and the maximum temperature for growth to be 77°F.

It is likely therefore that the effects of this disease would be less severe with higher temperature.

Control measures are recommended as follows:—

1. Crop rotation to avoid concentration of spores in the soil.
2. Removal and burning of diseased leaves and plant material to reduce sources of infection.
3. Clean weeding and removal of cruciferous weeds.
4. Spraying with a suitable fungicide may be desirable if the attack is wide-spread.

### 3. Brown Rot of Citrus (*Phytophthora hibernalis*).

This disease of citrus was first noted locally in 1941 when orange trees in bearing were found to be heavily infected—involving the loss of the whole crop of fruit.

This note may be opportune as the citrus crop is now approaching maturity.

*Symptoms.*—In the field, brown rot is usually first noted on fruit within three feet of the ground. The infected fruit develop brown spots but the skin and underlying tissues remain firm. As the fruits ripen the spots develop rapidly and the fungus penetrates the fruit. Secondary organisms gain entry and the fruit decays with a characteristic odour. The disease may also result in partial defoliation of the trees and is also the cause of a collar-rot of more or less serious status.

*Cause.*—The casual organism is a fungus—which is reproduced by means of motile spores. These develop on the surface of the soil and are splashed by the rain against low hanging fruit. These spores germinate and in from three days to a week cause a visible tan-coloured rot of the fruit. In local cases the infection has spread rapidly to all but the highest branches with heavy losses of fruit.

#### Control Measures.

Brown rot can be effectively controlled by spraying, by pruning away the lower branches and by cutting down tall weeds in the orchard.

In Australia spraying with Bordeaux oil mixture (4-4-80-½) before or immediately after heavy autumn rains has provided effective protection from the disease.(2) In Fiji the disease has not affected trees which have been pruned and sprayed annually.

It is recommended that where twig infection is heavy or where trees were heavily infected in the previous season, the whole of the tree should be sprayed, otherwise it may only be necessary to spray to a height of 4 to 5 feet above the soil. The lowest foliage should be one foot or more from the soil when weighted with fruit.

All fallen diseased fruits and leaves should be burned in order to reduce the amount of soil infection under the trees: and the cultivation of a low cover crop such as rice-bean may be regarded as beneficial.

Treatment of collar-rot caused by this organism has been described before(3) and observations during several seasons confirm the effectiveness of the methods recommended.

#### REFERENCES.

(1) Crisanto, T.—1924. "*Rhizopus artocarpi*: its Cultural Characteristics and its Relation to *Rhizopus nigericans*." *Philipp. Jour. of Agric.*, Vol. XII, pp. 465–468.

(2) "Brown Rot of Citrus."—1940. Agric. Gazette of N.S.W., Vol. LI, Pt. 2.

(3) Parham, B. E.—1937. "Citrus Diseases in Fiji." *Agric. Journal*, Fiji, Vol. 8, No. 4

RAINFALL IN SUVA, 1941.

| Month. | Inches. | Month. | Inches. |
|---|---|---|---|
| January .. .. | 7·24 | July .. .. .. | 3·59 |
| February .. .. | 13·57 | August .. .. | 13·79 |
| March .. .. .. | 5·54 | September .. .. | 13·21 |
| April .. .. .. | 45·45 | October .. .. | 2·81 |
| May .. .. .. | 7·18 | November .. .. | 9·65 |
| June .. .. .. | 10·02 | December .. .. | 11·69 |

Total, 143·74 inches; average, 119·65 inches.

# EXTRACTS.

## 1. FISHERIES AND AGRICULTURE COMPARED.

AGRICULTURE and fisheries belong to the same family of man's endeavours and are in fact very closely related. They both depend on farming a crop that grows and increases naturally. In both cases the crop has to be protected during its growth and harvested when it reaches maturity. But unfortunately fisheries are the runt of the family and in almost all countries including Palestine, knowledge of fisheries lags far behind that of agriculture or forestry or other kindred subjects.

It is the greatest pity that this should be so for fisheries have several outstanding advantages over Agriculture; fish if properly protected, can bring in better returns than any other crop. The main advantage of fisheries is that the stock already exists in the sea or lake and grows without help from man so that all labour and expense of cultivation are avoided. Thus there is no ploughing to be done nor manuring or other preparations of the ground, nor purchase of seed or stock, nor sowing, feeding, weeding or fencing. Further, fish are much less affected by the weather and climate than crops on land so that their farming bears less risk. The only labour or expense involved in fisheries is the actual fishing or harvesting of the crop. and the only protection needed is that the fishing methods should be such that the fish are not caught before they have reached maturity. Unfortunately, in most countries, usually through ignorance or greed, this small amount of necessary care is not taken and the fishermen instead of farming and improving stock only help to destroy it. Of the causes, ignorance is probably the more important and certainly the more easily remedied, and now at last the value and importance of research and scientific study of fisheries is gradually being realized.

The main reason why the study of fisheries has been so neglected is that fish are unseen in the water. As a result it is extremely difficult to study their habits and still more difficult to decide on a rational policy of farming. In agriculture before planting a crop, the original amount of grain, or number of plants, is known, the growth can be watched, the crop can be harvested when it is ripe, and the yield can be measured with accuracy. If the yield is not satisfactory, various experiments can be made, and the yield measured in each case, until gradually the most efficient method of farming that crop is determined. Similarly with animals, by observing the growth, it is possible to discover the most economical size for killing or marketing. But with fisheries the conditions are more difficult; it is really like farming in darkness. At no time is it possible to see the stock and determine its size as a whole, so that all fisheries start with a stock of unknown size. It is not possible to watch the fish grow and only after much labourious experiment is it possible to gain any idea of the rate of growth or of the age at which

the fish become mature. The only part of the fish farming process that can be measured accurately is the yield, but even then it is impossible to know whether the yield is satisfactory when all other factors about the stock are unknown. Further, unless the individual size at maturity is known, it is possible unknowingly to destroy a stock of fish completely by catching the fish when they are small and before they have had time to reproduce themselves. Such a thing is inconceivable on land where, in every part of the world, the farmer knows better than to cut his wheat before it produces ears or kill his hens before they begin to lay.

Another reason why the fisheries have been neglected is that any fault or inefficiency in fishing is unseen, like the fish themselves. Consequently not only is it more difficult to remedy the fault; it takes much more enterprise and imagination even to try and remedy a fault that cannot be seen than one that is glaringly obvious.

The great size of the ocean also brings a false sense of security, for people feel that with so much water and so much space there must be enormous numbers of fish everywhere that can take care of themselves. But few people realize that fish, like other crops, are particular in their habits and will only live in water of certain depth or temperature, or in regious where there are certain supplies of food. No matter how large the water may be, the places where a fish can live are strictly limited. No one would expect a crop on land to flourish on every kind of soil, and just as there are bare rocky hillsides unsuitable for plants and animals, there are barren parts of the sea that are unfavourable for fish.

Apart from the invisibility of the stock, fisheries differ from agriculture in that the stock is common property and that it is usually mixed in composition. The fact that fish stocks belong to everyone and yet no one is responsible for their care results in everyone grabbing as much as he can get at the moment without thought of the future or of the damage he may be causing. In agriculture the stocks and crops are generally privately owned and the owner takes good care to protect them energetically and to see that they are not killed or harvested too soon and that they do not take too much out of the soil. Where there are common stocks on land as in forests, it is now almost universally recognized that, if the trees are cut down, the region will become bare unless some active re-afforestation is carried out. Yet few people realise that, if they fish too intensively, the seas will also become barren unless they take careful precautions to ensure that only large and full mature fish are caught which have already been able to reproduce themselves.

Fish stocks are almost invariably mixed in composition and this makes them extremely difficult to harvest in a rational manner, for the component parts will vary in abundance, in shape, in rate of growth and they will reach maturity at different sizes and at different seasons. In agriculture the various crops are kept separate and any one field usually contains only one kind of plant which grows and ripens uniformly and can all be cut at one time. But the variations within a fish stock is rather like having a field with wheat, beans and turnips all growing mixed up together and they trying to decide at what season and at what height the field should be cut to get the maximum yield. Should it be cut close to the ground so that all the wheat and beans are used but the turnip plants are destroyed, or would it be better to cut a little higher so that some of the beans are wasted but the turnips are left undamaged to continue their growth? It is clearly impossible here, and with all mixed stocks, to make full use of each of the components. Careful calculations have to be made to determine a compromise which will give the greatest value while doing least damage to the

stock as a whole. To do this, the abundance, size and value of the different species have to be taken into account.

The harvesting of fish is usually done by nets and the size of fish taken is regulated by the mesh. With mixed stocks, it is clear that no mesh can be right for all the species concerned, a mesh that retains the young of one species may fail to hold the adults of another. But once a compromise size has been calculated, the mesh should be regulated to catch nothing below this size and it will be such that no immature specimens of the most abundant or most valuable species are caught.

So far it has been enphasized that the basic principles involved in fisheries are identical with those in agriculture, but that conditions in the sea and in lakes are such that it makes these principles more difficult to apply. The fact that the stock cannot be seen makes both fishing and the study of fish difficult. The fact that the stock is common property results, through ignorance and greed, in it not usually being properly looked after. The fact that the stock is mixed makes it difficult to harvest. But these difficulties are not insuperable and in such a place as the North Sea after many years of intensive and detailed study, a great deal has been learned about the stock of fish and a rational fishery has been developed. In this fishery the size and composition of the stock and its rate of increase have been estimated, and the methods of fishing are carefully controlled so that only fish of economic size can be caught. It is perhaps truer to say that in the North Sea there is now the basic knowledge necessary for a rational fishery, but there are individuals and nations who continue to disregard international agreements and regulations so that overfishing does still occur.

Finally it is interesting to know how the basic knowledge for a fishery is obtained. The size of the stock can be estimated from large scale marking experiments. If the fish are marked at random, it may be assumed that they are a true sample of the total stock. If this is so, then the number of marked fish recaptured will be in the same proportion to the total number of marked as the total catch of fish is to the total stock. Since the total catch of fish can be known, the size of the total stock can be estimated. The rate of increase of a stock depends on the number of fry produced, their mortality, their rate of growth, their age at maturity and the number of times each fish breeds. The average number of potential fry can be found from counting the eggs and from experiments in tanks. The rate of growth can be determined from marking experiments and from studies of scales. These will show that fish of different sizes will fall into different age groups and the difference in length between these groups gives an average yearly growth. The size and age at maturity is only determined by examining many specimens, and the number of times the fish breed will depend on their age.

When these factors have been studied in detail, and only then, is it possible to build up a rational fisherly policy in which the largest possible yield can be taken without damage to the stock. Till this information is available the fisheries are like harvesting in the dark and it is a combination of good sense and luck whether the harvesters get a good living or whether they do irreparable damage to their own food supply. In the meanwhile the general principles of successful agriculture should guide them away from the most dangerous pitfalls ,and they should always bear in mind that a properly regulated fishery brings good returns indefinitely, without large expenditure of money or effort.

*Agricultural Bulletin*, Palestine. Jan.–Mar., 1941, by Dr. G. C. L. Bertram, Chief Fisheries Officer, Palestine.

## 2. THE PRESERVATION OF FISHING NETS.

In an interesting article appearing in the *Palestine Agricultural Bulletin* for April 1941, Doctors G. C. L. Bertram and C. K. Ricardo discuss methods for the preservation of fishing nets. The following extract may be of interest to local fishermen.

Tars are good preservatives, but they are heavy and make the fibres stiff, and are therefore not suitable for most of the nets used in Palestine. Copper compounds are among the best preservatives, but probably have to be ruled out here on the grounds of expense. Cutching is the most useful general method. Recent work has shown that cotton nets boiled in cutch every three months last over four times as long as untreated nets. But if after boiling in cutch they are dipped in a solution of ammoniacal copper sulphate their life may be again doubled, so that they last as much as eight times as long as untreated nets. With this second method, treatment need only be every four months. Neither cutch nor the copper solution is expensive and it is very well worth while treating nets in this way even if the results in this climate are not quite as good as elsewhere in the world.

But in nets where there is a large strain on the fibres as in trawls, and also in fill ropes, the problem of preservation is rather different. Firstly the twine is thicker and therefore more difficult to dry, and secondly there may, especially in ropes, be considerable movement of the strands over one another. This causes friction within the rope and gradually lessens its strength. A preservative for thick twines and ropes should, therefore, have good powers of penetration and also lubricating action to reduce the amount of wear within the rope. The treatment described above can be used, but better results are generally obtained with a tar, preferably a light coal tar, with 10 per cent of copper oleate or copper naphthenate added as lubricant.

Nets should always be very well dried and treated with preservative before they are put away in the store, in order to protect them against lurking bacteria. Net preservation exemplifies the proverb that "a stitch in time saves nine," for a little cutch may save the fisherman nine new nets.

—H.W.J.

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## 3. TUNG OIL.

This oil derived from two species of *Aleurites* (*A. Fordii* and *A. montana*) if of immense economic value in the paint and varnish trades.

Trials of growing the trees are being watched with interest in Ceylon where it has been shown that the *A. Fordii* does not thrive satisfactorily but that *A. montana* is definitely promising though little is yet known of its yielding ability. Further information is given in a summary report which appears in the *Tropical Agriculturist* Volume 97, August, No. 2, 1941. It may be mentioned that small scale experimental plantings of *Aleurites montana* in Fiji also show encouraging prospects, though it will not be possible to provide reliable yield data for several years. —H.W.J.

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## 4. FOOD AS A WEAPON.

"Food is a weapon against Hitlerism just as much as munitions and food will continue to be a weapon in all efforts towards ensuring a more orderly, prosperous and peaceful world." —PRESIDENT ROOSVELT.